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The Effect of Environment on Facet Number in the Bar-Eye Mutant of Drosophila

THE EFFECT OF ENVIRONMENT ON FACET NUMBER IN THE BAR-EYE MUTANT OF DROSOPHILA

BY

ERNEST WILFORD SEYSTER
A. B. University of Illinois, 1915.

THESIS

Submitted in Partial Fulfillment of the Requirements for the

Degree of

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IN ZOOLOGY

IN

THE GRADUATE SCHOOL

OF THE

UNIVERSITY OF ILLINOIS

1917

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UNIVERSITY OF ILLINOIS

THE GRADUATE SCHOOL

June 1, 1917

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Ernest Wilford Seyster

ENTITLED The Effect of Environment on Facet Number in the Bar-Eye Mutant of Drosophila

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF Master of Arts

Charles Zeleny
In Charge of Thesis

Henry B. Ward
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Recommendation concurred in:*

Committee
on
Final Examination*

*Required for doctor's degree but not for master's.

7 Feb 18 Gilley

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THE EFFECT OF ENVIRONMENT ON FACET NUMBER IN THE BAR-EYE MUTANT OF DROSOPHILA.

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THE EFFECT OF ENVIRONMENT ON FACET NUMBER IN THE BAR-EYE MUTANT OF DROSOPHILA.

I. Introduction.

For the past three years experiments have been in progress in this laboratory to determine the effect of selection upon the facet number of Drosophila. In connection with this rather extended series of experiments, the question of the effect of environment on facet number was taken up in order that the effect of such influences upon selection might be reduced to a minimum.

The general effect of temperature on insects is fairly well known, while but little is known about the effects of moisture. Loeb, working on Drosophila, found that between 28°C and 9°C the average duration of life is doubled by a fall of ten degrees. Little work has been done, however, on the effect of environmental influences on Mendelian characteristics in this form. Morgan states that in dry food the abnormal banding occurred very seldom, while in moist food this character was well developed and gave a regular Mendelian ratio, the effect of which was obscured by dryness in the food. A somewhat similar instance has been reported by Miss Hoge, as regards the influence of temperature upon the production of supernumerary legs in a Mendelian ratio. In this case the factor for extra legs may be transmitted, but at

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ordinary temperatures the effect is obscured, and it is only at the lower temperatures that the factor shows itself.

The present paper deals particularly with the effect of temperature upon facet number.

Methods.

II. The long wing red "bar" eye Drosophila was used in these investigations with the exception of experiments 14, 15 and 17 in which the white bar eye stock was used, because of its greater viability. The flies were reared in either large mouth bottles of 140 c. c. or 230 c.c. capacity. The same size of bottle was used throughout each experiment.

Banana, which had been sterilized in a steam sterilizer, was used as food. In most cases a little yeast was added after the food had cooled, although development proceeded more rapidly and a larger number of individuals was obtained without the use of yeast provided mould did not develop too rapidly. The food proposed by Metz and agar-agar food were both tried but with little success. An attempt was made to keep the moisture the same in the different bottles of each experiment.

For the higher temperatures (27° -- 30° C) a bacteriological incubator was found very satisfactory, varying not more than 0.5° C. The room temperature, recorded by means of a thermograph, was, for the most part quite constant, and did not usually vary more than 2° C. A cold plate was easily arranged by allowing tap water to flow around a dish in which the Drosophila bottles were placed. The temperature here did not vary more than one degree during any experiment.

The parents in each experiment were taken from mass cultures or stocks, no attempt being made to obtain virgin females for this work. However, the average facet number of the parents of any two sets in an experiment differed but little, any difference occuring being much less than the difference between the averages of the offspring raised at different temperatures. In experiments 14, 15, 17, and 18 the parents were left in the bottles for one day only; in all other experiments they were allowed to remain for nearly the full developmental period of the fly at that temperature in order that a larger number of individuals might be obtained.

In counting, a No. 4 eye-piece and a No. 3 Leitz objective were used. The area of the eye in arbitrary units was found by making an outline camera lucida drawing of the eye and measuring the enclosed area with a polar planimeter, which instrument was found to give very accurate results to 1/100 of a square inch. In some cases the facets were counted after the flies had been preserved in alcohol but mostly the counts were made shortly after the emergence of the flies from the pupa cases. In order to determine the per cent of error made in counting a set of ten flies, (5 males and 5 females) was counted at two different times. The result was as follows:-

First count		Second count	
158	135	156	137
160	111	159	108
153	115	151	114
118	106	128	104
169	122	178	121
Total 1347		1356	

Per cent error between two counts

0.82%

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

	[illegible]		[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

For a larger number of individuals the per cent error would probably be less than this; for single individuals it was found to average about 5% to 7%.

DATA.

III. Experiment 1,2,3. The effect of temperature on facet number. The first experiment tried was to test the effect of different amounts of food on facet numer. Three bottles, each containing a different amount of food and thirteen pairs of flies as parents, were placed in a small well-lighted room where the temperature was kept at approximately 27 C. After seven days the parents were taken out and their facets counted. Offspring were removed from the bottles as they hatched and a count made of their facets. It was found that the facet number of the offspring in each of the three bottles differed slightly from each other but that their average facet number was decidedly lower than that of the parents. In the male flies this difference was 26, and in the female flies 35. A count of the stock was made at the end of the experiment, and it was found that here the facet number had increased greatly, the average for the males being 50 higher than that of the parents, and for the females 30. Previous to the time of the experiment, the stock had been kept in a room where the temperature was approximately 21 C - 23 C, while, during the time of the experiment, it was kept at

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

19 C - 21C.

Experiment 4. These experiments indicated that temperature was an important factor in facet variation of the bar-eye. To test this farther one set of Drosophila was placed in an incubator, where the temperature was 28.5 C, another was kept at room temperature, (22°), and a third set was placed on a cold plate at a temperature of 17 C. and the offspring were allowed to develop at these temperatures. In facet number those which developed at room temperature differed but little from the parents, those which developed at 17° were decidedly higher, while those which developed at 28.5° C showed a marked decrease in facet number. In this experiment, the electric current of the incubator was turned off for one and one half days so that the developing flies were at room temperature for that length of time. In the counts, the effects of this may be noted as about one ninth of the flies is much higher than the rest, the developmental period being nine days at a temperature of 28.5°C. The temperature of the cold plate was also allowed to rise to that of the room twice for about three hours each, so that the results from this experiment are somewhat less striking as regards the differences between high and low facet numbers.

Part of the offspring of 4.1 and 4.2 was used as parents

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[illegible]

[illegible]

in similar experiments (experiments 4.1, 4.2) only here there was no room temperature. The results obtained from all four sets are analagous to those obtained from experiment 4. Whether or not the facet number of the F_2 flies is in any way affected by the temperature at which the F_1's develop is yet to be determined although the following results and some of the other work would seem to indicate that the effect, if any, is slight. (See also experiment 5.1 and 5.2)

The following experiment is the most conclusive as a high temperature of 29 and a low temperature of 17.5 were maintained throughout the time of experiment. The male flies developing at a low temperature showed an average facet number three times as great as those developing at high; the female flies developing at a low temperature gave a facet number 4.7 times that of those developing at high. In the parents the difference between the averages of the sets was, in the males 2 and in the females 10, and in both males and females those having the highest facet average gave the lowest offspring, these being the ones that developed at 29°. The extreme variates (high, low) of the parents of the two sets are slightly greater in the case of those which developed at the lower temperature, but as the greater difference here is only eleven facets, and as the difference between the variates of the two sets of offspring is as great as 145, it is certain that selection can play no very great role in determining the facet number of the offspring here noted.

A part of the offspring from experiment 5.1 was continued as a "hot" line for five generations at 29 C. The fifth generation gave an average of 63, the females had an average of 35; the males were lower and the females higher than the first generation of offspring of 5.1.

In experiments 14, 15 and 17 the effect of temperature on the white bar-eye Drosophila may be noted, and the results are fully concurrent with the results obtained from the work on the red-eye. Experiment 18 also gives additional data on this question.

The above four experiments were made in order to determine the period of development when temperature was most effective. Is temperature effective throughout the larval and pupal stages, or is its major effect confined largely to the early stages of development? To determine this, five bottles with parents were placed in an incubator (29° C) and the developing files in the different bottles allowed to pass different fractions of their developmental period here. They were then removed to the cold plate at 15° C, or room temperature (22° C), and allowed to complete their development at these temperatures. One bottle was kept on the cold plate throughout the period of development, and another was kept at 29° C. Other removals to a lower temperature were made as follows: Number 2 after one-half day; number 3 when the larvae

were about one-third grown, (2-2½ days); number 4, just before pupation had started; number 5 after the most of the larvae had transformed into pupae; and number 6 was kept at 29°. In experiment 18, the change from room temperature (22°) to 29° was made, and instead of using white bar-eye flies, the red bar-eyes were used. As the parents were allowed to remain in the bottles for one day, the length of time the developing flies were allowed to remain at the initial temperature was reckoned from the beginning of that day and not from the beginning, in order to give the mean time of development at that temperature for all the eggs laid during that day.

In experiments 14 and 15 the effect of temperature is to be noted early in the larval period; in 17 and 18 which were changed from 29° to 22° and from 22° to 29° respectively the effect of temperature is to be noted throughout the larval life. In no case was there any effect of temperature upon the facet number of the flies after the pupae had been formed. The parent flies of the different six sets differed but little in facet number. In experiments 14, 15, and 17 each set of parents was used once in each experiment. For instance, the parents of 14.1, 15.3, and 17.2 were identical, etc. In experiment 18 the same parents were used throughout. (See Exp. 14, 15, 17, 18)

The number of facets per degree change in temperature varies from 5.2 to 8.9 with one exception, and is fairly constant. Following is a list of factors found by dividing the difference in facet averages by the difference in degrees temperature at which the flies developed.

Experiment	Temperature difference	Facet difference	F/degree
123 males	22° -- 27°	26	5.2
123 females	22 -- 27	34	6.8
4 males	17.5-- 22	32	7.1
4 males	22--28.5	41	6.3
4 females	17.5-- 22	61	13.5
4 females	22-- 28.5	43	6.6
5 males	17.5-- 29	111	8.9
5 females	17.5-- 29	100	8.0

The relation between the facet number and a ten degree drop in temperature is also a very interesting one. Is the number of facets from two to three times as great with a ten degree drop centigrade? The following table gives the factor for facet increase per ten degree decrease C.

Experiment	Factor males	Factor females
1, 2, 3	2.6	3.5
4.0	1.7	3.0
5.0	2.5	3.9
5.1	3.0	3.2
Average	2.6	3.5

The relation of the area of the eye to facet number was found to be a constant within the range of error for flies with

an intermediate number number of facets. This constant has an average value of .685 for 43 individuals and was found by dividing the facet number by the area of the camera lucida drawing in 1/100 sq. in. In flies with a small number of facets the facet area was restricted; in too large an eye the curved surface made it very difficult to obtain accurate areas. However the above shows that the change in facets is accompanied by a change in the size of the eye, and that there is no change in the size of facets.

Acidity. But one experiment was completed on the effect of acidity of food and this gave no significant difference, although the differences in the food were greater than usual. The food of 11.1 was very acid in odor due to long fermentation, while no yeast was added to the food of 11.2 and consequently it developed no acid odor whatsoever. The date concerning this experiment are given below.

Parents				Offspring			
11.1		11.2		11.1		11.2	
115	68	102	63	62	32	65	41

In other experiments which were tried, the acidity was made stronger by the addition of glacial acetic acid. Mostly

the development proceeded through part of the pupal stage but no farther, the flies not emerging from their pupae cases. Here it is interesting to note, in connection with other work done on acidity, that the time of development is greatly lengthened in acid media.

1,2,3, males

	Parents				Offspring				Dif.of F_1 from P	Stock at end of exp.
Cat no	1	2	3	Total	1	2	3	Total		
Dev. t	---(21°--23°)---				+-+-+---27 -----					19°--21°
No ind	11	10	8	29	25	20	21	66		24
Facet ave	105	112	106	108	85	86	77	82	26	164
Error±				3				1.7		
High	149	164	126	164	162	178	140	178	14	202
Low	77	86	84	77	39	45	36	36	41	112
Coef var				20				41		

1,2,3, females

	Parents				Offspring				Dif.of F_1 from P	Stock at end of Stock at end of exp.
Cat no	1	2	3	Total	1	2	3	Total		
Dev. t	---(21°--23°)----				----27°---------					19°--21°
No ind	13	12	10	335	30	30	18	78		19
Facet ave.	75	89	83	82	47	54	42	47	35	109
Error ±				2.2				1.3		
High	100	127	98	127	88	102	86	102	25	146
Low	43	52	65	43	31	30	26	26	17	54
Coef var				24				21		

4.males

	Parents				Offspring			Differences	
Cat.no.	4.1	4.2	4.3	Total	4.1	4.2	4.3	17.5°-22.0°	22°--28.5
Dev. t.	22°	22°	22°	22°	28.5°	17.5	22		
No. ind.	10	13	12	35	80	29	17		
Facet ave.	135	135	122	121	80	153	121	32	41
Error ±			3.4	3.4	2.6				
High	192	174	180	192	161	202	186	16	25
LOw	101	77	82	77	41	120	87	33	46
Coef var.				24.7	42.7				

4. females

No. INd.	22	21	24	67	63	18	25		
Facet ave.	84	75	76	79	45	149	88	61	43
Error ±				1.4	1.0				
High	120	109	113	120	83	188	128	60	45
Low	43	57	44	43	20	106	62	44	42
Coef. var				23	19.5				

4.1 males

	Parents			Offspring		Differences in facet ave. from parents	
Cat. no.	4.11	4.12	Total	4.11	4.12	28.5°-- 28.5°	17°-- 28.5°
Dev. t.	28.5°	28.5°	28.5°	28.5°	17°		
No. ind.	10	13	23	19	5		
Facet ave.	89	72	79	66	135	19	56
High	140	120	86	86	148	54	28
Low	60	43	43	44	116	16	73

4.1 females

	Parents			Offspring			
No. ind.	13	17	30	21	4		
Facet ave.	54	46	49	58	115	9	66
High	83	76	76	94	122	11	46
Low	47	31	31	40	106	7	75

4.2 males

	Parents			Offspring		Differences in facet ave. from parents	
Cat. no.	4.21	4.22	Total	4.21	4.22	28.5°-- 28.5	17°-- 28.5°
Dev. T.	17.5°	17.5°	17.5°	28.5°	17°		
No. ind.	13	11	24	31	9		
Average F.	158	151	155	94	185	61	30
High	202	172	202	138	228	64	56
Low	128	131	128	50	136	78	5

4.2 females

No. ind.	10	8	18	38	18		
Facet ave.	142	136	139	55	99	84	40
High	163	165	165	74	121	89	44
Low	108	106	106	28	65	80	41

5 males

	Parents			Offspring		Differences in facet ave.
Cat. no.	5.1	5.2	Total	5.1	5.2	17.5°--29°
Dev. t.	22°	22°	22°	29°	17.5°	
No. ind.	10	10	20	86	64	
Facet ave.	129	127	128	56	167	111
Error ±			5.6	.9	3.0	
High	200	211	211	98	226	128
Low	90	80	80	34	74	40
Coef. var.			29	24	22.5	

5 females

	Parents			Offspring		Difference in facet ave.
Cat. no.	5.1	5.2	Total	5.1	5.2	17.5°-- 29°
Dev t	22°	22°	22°	29°	17.5°	
No ind	12	12	24	71	75	
Facet ave	97	87	92	27	128	101
Error ±			3.0	0.5	1.5	
High	138	144	144	43	188	145
Low	34	53	34	16	83	67
Coef var			25	21	20	

5.1 males

	Parents	Offspring		Difference in facet ave from parents	
	from 5.1 offspring	5.11	5.12		
Dev t	29°	29°	17°	29°	17°
No ind		7	21		
Facet ave		51	183	5	127
High		61	303	37	205
Low		38	127	4	93

5.1 females

No ind	16	26		
Facet ave	38	147	11	120
High	55	235	12	192
Low	27	111	11	95

Following counts are from three more generations at 29° C--continuations of 5.11 line.

	Males			Females		
Gen. no.	3	4	5	3	4	5
Facet ave	42	56	63	35	44	35
No ind	17	7	55	9	25	52
High	58	86	130	46	56	49
Low	32	43	31	28	25	20

Parents 14, 15 , 17. Developed at 27° C.

Males

Cat no.	14.1 15.3 17.2	14.2 15.4 17.3	14.3 15.5 17.4	14.4 15.6 17.5	14.5 15.1 17.6	14.6 15.2 17.1
No ind	16	14	15	6	12	15
Facet ave	117	115	106	120	117	108
Error ±	4.6	6.0	3.8	6.9	5.9	4.8
High	166	206	136	126	161	184
Low	56	60	72	82	82	75

Females

No ind	24	22	19	18	18	23
Facet ave	73	69	77	74	18	23
Error ±	2.6	2.2	2.2	2.7	2.2	2.2
High	107	1 03	116	110	102	102
Low	44	44	57	48	38	40

14. Offspring-- --Part of development at 29° --rest at 15°

Males

Cat no	14.1	14.2	14.3	14.4	14.6	14.5
No das at 29°	0	1/2	2	4 1/4	6 1/2	7 1/2
Dev period das	33	31	28	21 1/2	10	8
No ind	6	9	13	6	37	22
Facet ave	282	272	352	57	64	76
Error ±	13	7.3	9	2	2.4	1.7
High	366	325	414	65	130	161
Low	240	217	280	52	45	39

Females

No ind	10	21	18	10	25	21
Facet ave	215	266*	231	56	56	54
Error ±	11	16	5	2.4	1.4	1.1
High	288	650*	281	84	86	80
Low	147	190	171	43	39	48

15. Offspring---Part of development at 29°--rest at 15°.

Males

Cat no	15.1	15.2	15.3	15.4	15.6	15.5
No days at 29°	0	1/2	2 1/2	4 1/2	9	all
Dev period days				21	11 1/2	9
No ind	4	17	4	2	21	19
Facet ave	304	271	293	76	63	54
High 324	324	402	326	88	88	98
Low	290	161	248	65	40	42

Females

No ind	2	18	8	2	27	32
Facet ave	172	188	233	41	41	43
High	180	233	289	47	66	63
Low	164	130	178	36	33	27

Experiment 17 Part of development at 29° --rest at 22°.

Males

Cat no	17.1	17.2	17.3	17.4	17.5	17.6
No das at 29°	0	1/2	2 1/2	4 1/2	7 1/2	all
Dev period das	12	12	12	11	8 1/2	8 1/2
No ind	31	6	5	45	25	25
Facet ave	131	170	127	102	65	69
Error ±	2.9	7.4	8.1	2.4	3.6	2.5
High	171	198	180	150	144	129
Lowl	102	125	96	36	32	42

Females

No ind	32	8	4	50	30	29
Facet ave	114	130	101	66	39	44
Error ±	2.4	3.0	5.1	2.3	1.0	1.0
High	172	160	117	132	62	61
Low	80	112	80	32	25	31

Experiment 18 Part of development at 22° -- rest at 29°.

Red bar-eye.

Males					
Cat. no.	18.5	18.2	18.3	18.4	18.1
No. das. at 22°	0	2 1/2	6 1/2	9 1/2	all
Dev. period das.	8 3/4	9 3/4	11	11 3/4	12 1/2
No. ind.	9	12	11	14	8
Facet ave.	89	98	146	175	189
High	167	166	164	210	291
Low	49	64	65	128	124

Females					
No. ind.	4	11	13	19	12
Facet ave.	40	45	104	150	130
High	47	68	172	183	213
Low	35	35	52	120	101

Description of Plates.

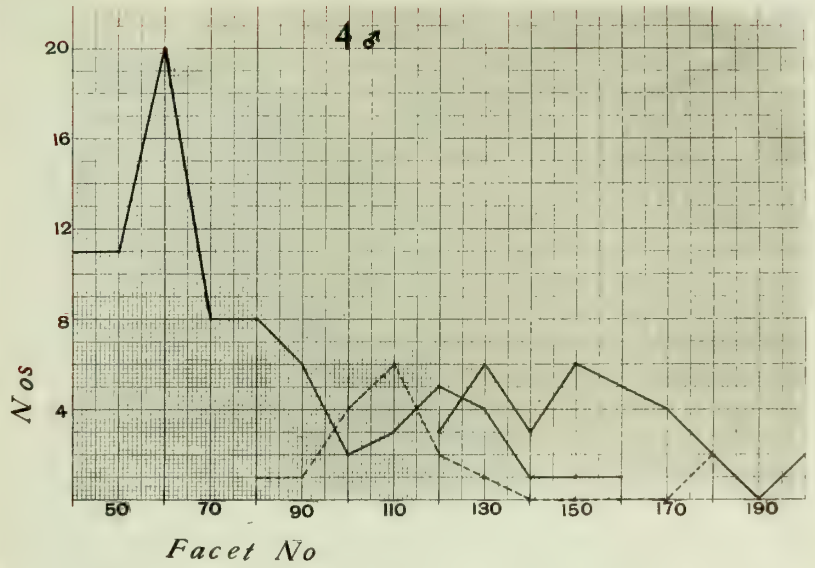
Plate I-- Exp. 4. Effect of temperature upon facet number. Abscissa shows facet number; ordinate, number of individuals in each class. Curve to the right shows individuals raised at 17.5; dotted line, parents; curve at left, individuals raised at 28.5.

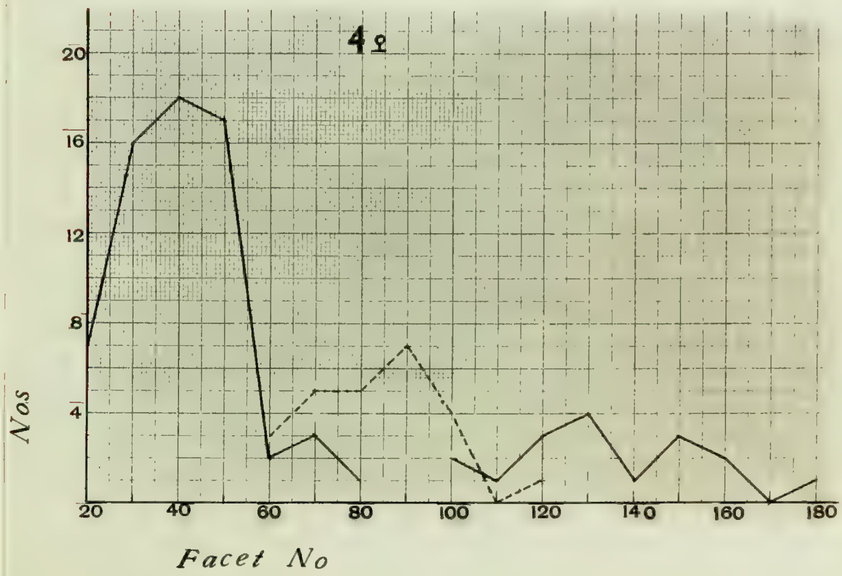
Plate II-- Exp. 5. Same as for 4. Curve at right, individuals raised at 17.5; dotted line, parents; curve at left, individuals developed at 29.

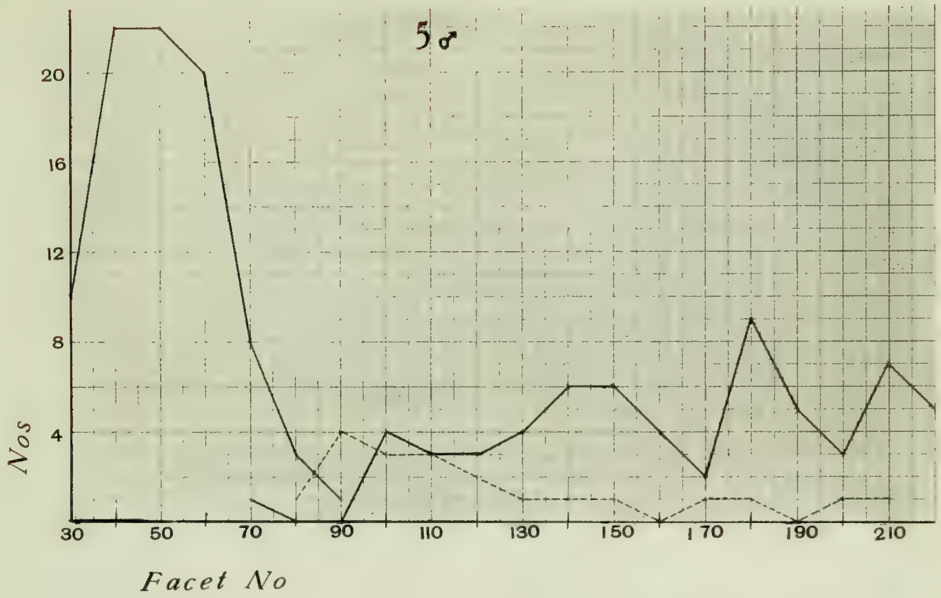
Plate III-- Period of development at which temperature is most effective. In 14, 15, 17, ordinates show facet averages of the different sets, abscissas show the number of days each set was kept at 29° before being transferred to a lower temperature of 15° for Expts. 14 and 15, and 22° for Expt 17. Figures at the top of graph show the number of individuals used in each average.

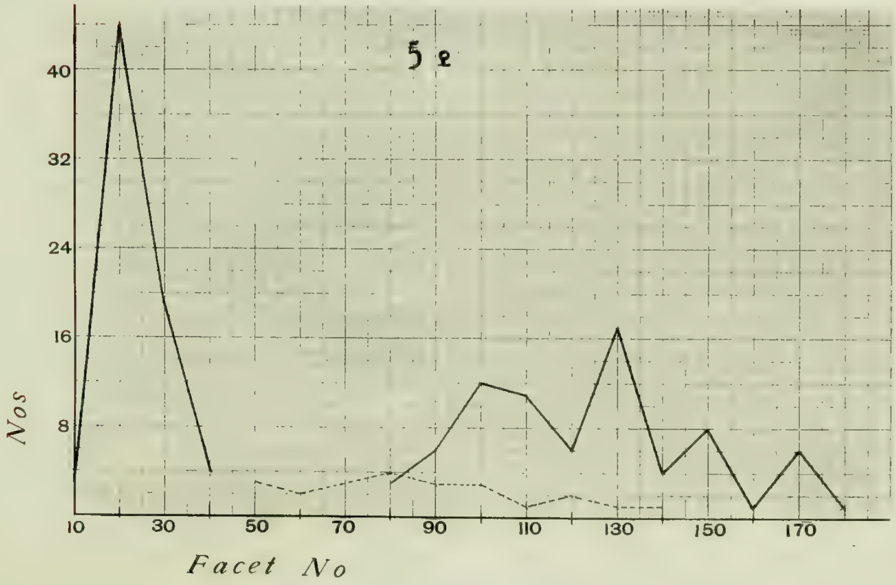
Plate IV-- Relation of facet number to area of eye in white bar-eye. Distribution of forty-three cases around average represented by line. Camera lucida drawings of eye with facet number.

PLATE I.


4 ♂
20
16
12
8
4
Nos
50
70
90
110
130
150
170
190
Facet No

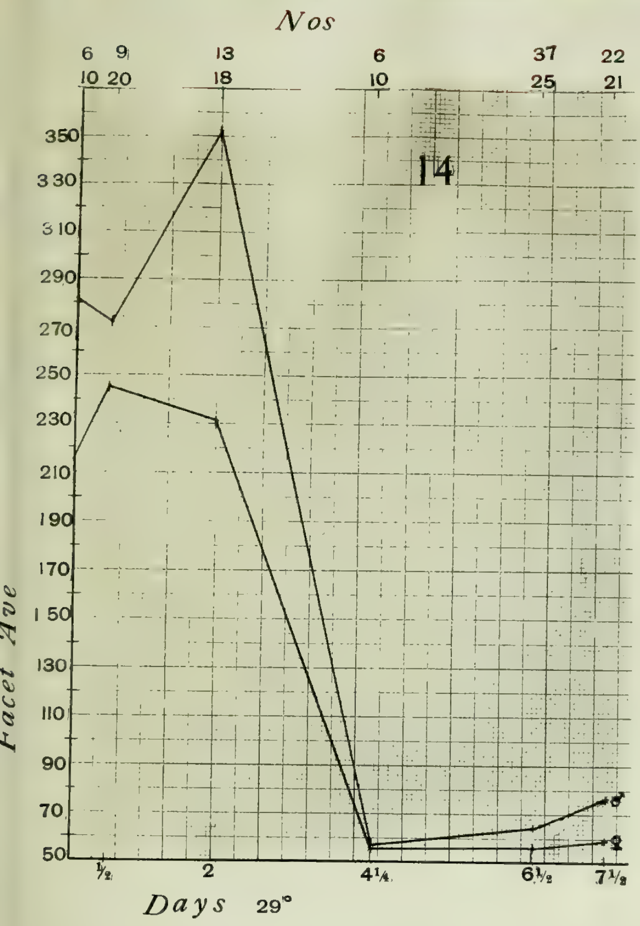

4 ♀
20
16
12
8
4
Nos
20
40
60
80
100
120
140
160
180
Facet No

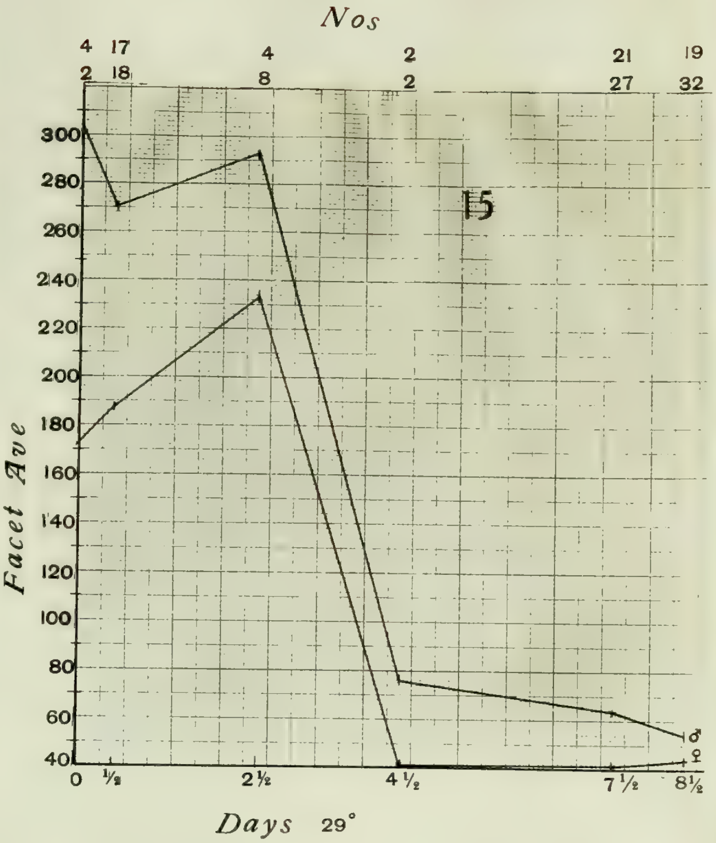

5 ♂
Nos
20
16
12
8
4
30
50
70
90
110
130
150
170
190
210
Facet No

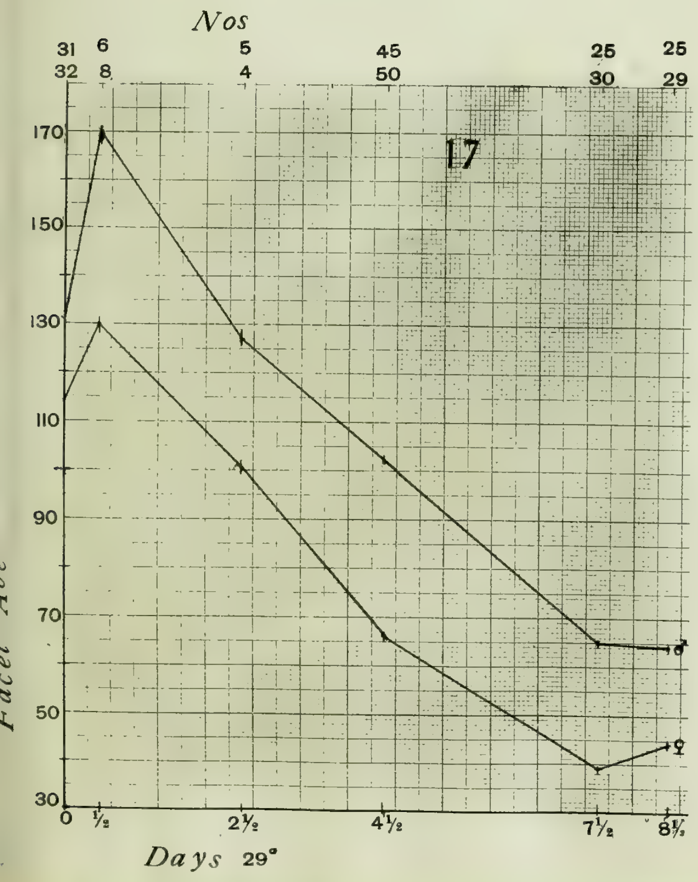

5 ♀
Nos
40
32
24
16
8
10
30
50
70
90
110
130
150
170
Facet No

25.

PLATE III.


Nos
6 9 13 6 37 22
10 20 18 10 25 21
14
350
330
310
290
270
250
230
210
190
170
150
130
110
90
70
50
Facet Ave
½
2
4¼
6½
7½
♂
♀
Days 29°


Nos
4 17 4 2 21 19
2 18 8 2 27 32
15
300
280
260
240
220
200
180
160
140
120
100
80
60
40
Facet Ave
0
½
2½
4½
7½
8½
♂
♀
Days 29°


Nos
31 6 5 45 25 25
32 8 4 50 30 29
17
170
150
130
110
90
70
50
30
Facet Ave
0
½
2½
4½
7½
8½
♂
♀
Days 29°

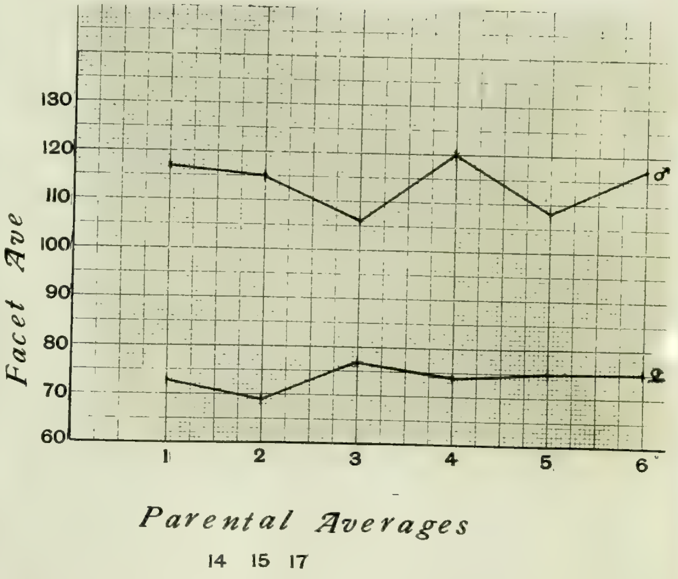
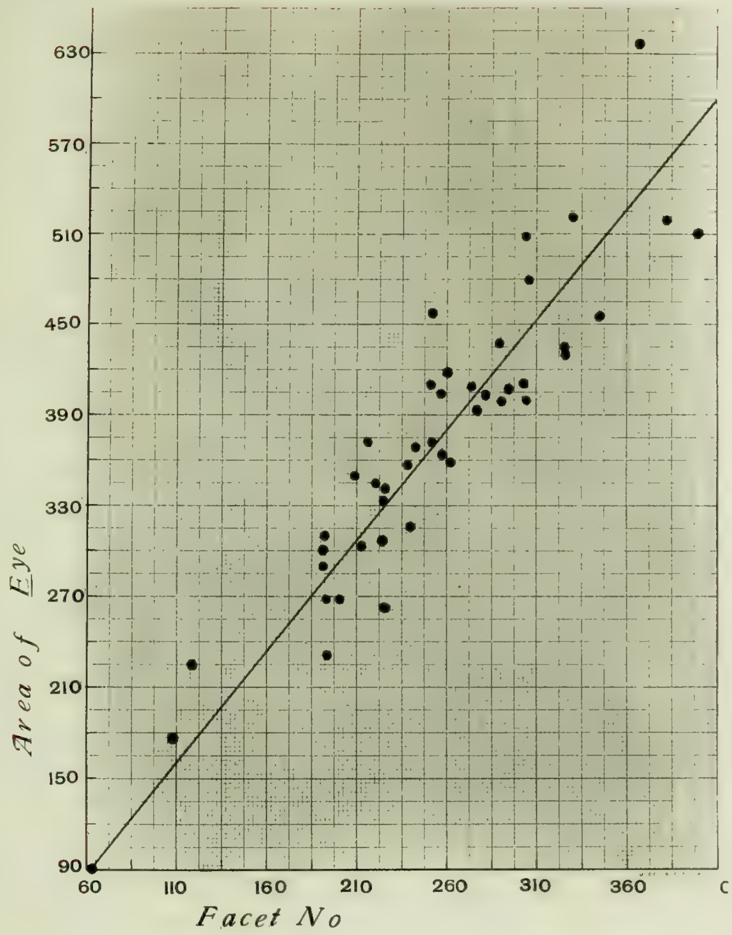
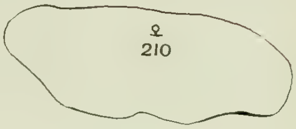
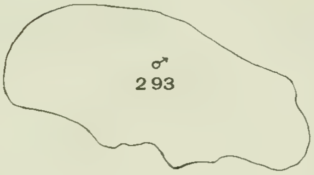
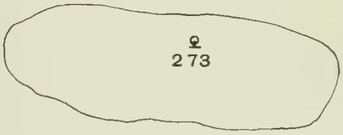

130
120
110
100
90
80
70
60
Facet Ave
1
2
3
4
5
6
♂
♀
Parental Averages
14 15 17

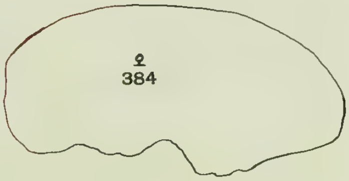
PLATE IV.

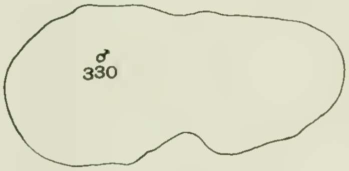

Area of Eye
630
570
510
450
390
330
270
210
150
90
60
110
160
210
260
310
360
Facet No

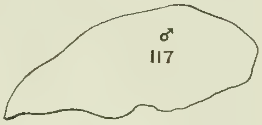

♀
210

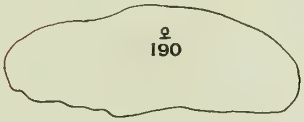

♂
293

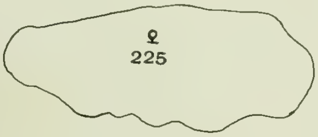

♀
273

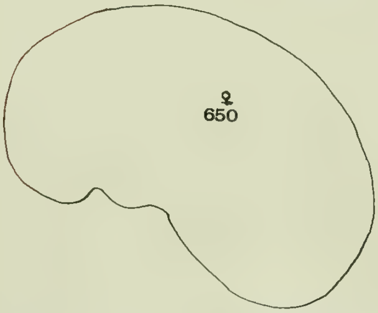

♀
384

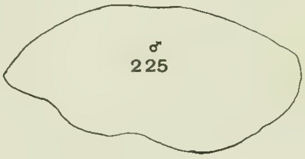

♂
330

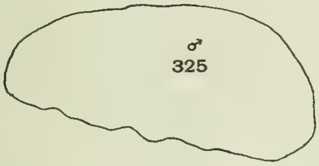

♂
117

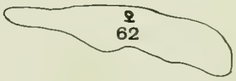

♀
190


♀
225


♀
650


♂
225


♂
325


♀
62

DISCUSSION

V. Effect of temperature on Facet Number. Observations upon ~~which~~ the red and white bar-eye show that temperature is an important factor in determining facet number of the flies taken at random from a general population. Flies raised at a higher temperature, however, do not have a higher number of facets, but, on the contrary, the higher the temperature of development, the lower the facet number. An explanation which may be offered presupposes the existence of a chemical factor or determiner which acts as an inhibitor of facet formation and that, at a higher temperature, the speed of reaction is much greater than at a lower. Then, according to Van Hoff's law, with an increase of 10°C the speed of the reaction should be from two to three times as great and the number of facets one half to one third times as large, and vice versa. An examination of the data shows that this is true.

In the males with a 10°C decrease the facet average is 2.6 times as great; in the females 3.5 times. Whether or not the high factor, 3.5, in the females is due to the fact that the bar-eye is a sex linked factor and the female receives two chromosomes containing this factor, where the male receives but one is a matter for speculation. Experiments are now in progress to determine whether the restraining factor is present in the full eye fly or not.

[illegible]

[illegible]

[illegible]

[illegible]

In ordinary banana food, acidity is probably a small factor in the regulation of facet number. By adding a weak acid, such as acetic, the time required for pupation was considerably lengthened. However under such conditions no flies hatched out and no counts were obtained.

That it is not light which is the important factor is shown by the fact that the effect of temperature is very marked whether both sets are reared in incubators at different temperatures, or in well-lighted rooms at different temperatures. Whether or not dryness plays any part in the regulation of facet number has not been decided although it is likely since there is no regular marked change in facet number as the food grows dryer, that moisture is not a very important factor.

Period of development at which temperature is most effective. Because of the fact that such Diptera as Culex, Corethra, Simulium, Chironomous, Ceratopogan and Muscidae, the facets are formed during the larval period, it was expected that any effect that temperature might have would be confined to the larval stage of development. It was found that the temperature was most effective during the first part of the larval life, and that it had no effect whatsoever during the pupal period of development. That its effect is negative or less strongly marked during the later part of the larval life is probably due to the fact that fewer facets are formed at this time.

Summary.

1. Temperature is an important factor in the determination of facet number in the bar-eye of Drosophila.

2. A lower developmental temperature results in a higher facet number, and conversely a higher temperature results in a lower facet number.

3. With each 10° drop in temperature between 29° and 15°, the facet number is increased 2.6 times in the males and 3.5 times in the females.

4. The increase in facet number is directly proportional to the increase in the area of the eye, and facet-size is therefore a constant.

5. Light, amount of food, dryness and acidity, as they ordinarily occur in Drosophila work, are not important factors in the determination of facet number in the bar-eye.

6. Temperature is effective thruout the period of larval development, but it is not as effective in the later as in the earlier part.

This work was done under the direction of Dr. C.Zeleny, and I wish to express my thanks to him for his interest in the problem and for his many suggestions while it was in progress.

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APPENDIX

(Containing record of counts.)

Parents, 1,2,3. Offspring, 1,2,3. 31.

Parents

♂ 1.	♀
149	43
77	65
77	46
79	60
84	79
107	62
132	56
92	98
88	100
125	97
145	196
	76

♂ 2.	♀
100	127
104	115
164	62
125	111
91	102
106	98
86	70
119	74
124	110
102	73
	52
	79

♂ 3.	♀
113	89
125	98
101	74
103	84
104	85
84	72
126	95
94	87
	65
	78

Offspring

♂ 1.	♀
72	60
78	42
99	88
103	43
111	47
78	43
69	68
82	41
82	56
81	35
64	59
162	54
39	50
52	39
59	49
140	45
100	41
71	42
94	41
69	39
72	56
91	44
85	45
105	38
58	40
	39
	31
	38
	57

	♀
..	50 50
..	40
..	72
..	58
..	58
..	57
..	69
..	58

♂ 2.	♀
120	56
178	70
93	43
56	46
94	62
106	44
67	102
117	85
54	48
90	62
45	30
67	55
71	44
94	47
75	35
99	61
88	44
72	43
58	43
68	35
	51
	52

♂ 3.	♀
107	40
68	43
92	62
56	86
80	44
54	39
100	52
72	42
54	41
78	32
74	33
140	35
138	40
56	35
67	43
71	32
65	26
75	32
69	
56	
36	

Stock. ...

♂	♀
185	101
202	77
175	54
112	125
200	112
152	86
130	94
200	122
145	122
165	90
137	129
160	123
166	114
140	109
156	128
194	135
161	106
186	146
184	106
130	
176	
192	
157	
123	

II.

4.1
P ♂
136
103
137
101
120
161
192
147
136
118

4.2
P ♂
160
77
110
163
121
174
161
144
144
124
114
123
146

4.3
P ♂
82
115
88
119
89
180
178
86
116
131
150
133

4.1
P ♀
90
54
54
99
110
43
102
78
81
82
87
80
90
87
61
114
58
68
84
90
121
120

4.2
P ♀
72
92
72
59
109
61
94
88
59
82
70
79
71
85
57
86
79
69
85
69
76

4.3
P ♀
68
54
54
58
78
84
113
72
55
112
55
74
75
63
88
93
107
74
89
44
76
68
46
89
81

4.1
F₁ ♂
(4.11)
P♀
80
118
86
77
68
140
67
60
105
93

(4.12)
P ♂
60
98
64
78

43
120
55
64
54
76
69
63
93

89
63
136
64
45
66
85
84
63
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58
94
123
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71
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47
97
156
161
129
105
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62
61
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115
134
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126

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112
131
86
89
54
64
46
41
72
60
82
42
43
49
77
60
51
60
44

4.1 ♀ F.
(4.11 ♀ P)
47
48
58
49
60
59
83
47
53
48
48
50
50

(4.12
P♀)
37
32
39
61
76
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73
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38
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23
38
73
32
27
45
42

4.2 F₁ ♂
(4.21
P ♂)
156
142
150
135
128
174
202
155
186
136
134
188
165

4.22
P ♂
155
162
138
146
131
135
161
158
172
156
143

160
168
175
120
178

4.2 F₁ ♀
(4.21
P ♀)
138
154
163
133
125
188
127
151
138
108

(4.21
P ♀)
141
125
106
138
165
139
156

4.3
F₁ ♂
132
111
118
107
87
95
109
182
120
116
126
115
186
112
104
121

4.3 F₁ ♀
81
79
92
107
108
75
97
89
62
83
95
84
71
67
71
128
67
94
105
82
78

102
96
92
95

III.

4.11
F ♂

78
74
64
76
70
75
61
86
78
81
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64
44
62
54
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51
67

411
F ♂

62
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43
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94
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4.12
F ♂

148
116
138
144
128

4.12
F ♀

117
122
106
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4.21
F ♂

132
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4.21
F ♀

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4.22
F ♂

168
182
153
215
170
207
136
202
228

4.22
F. ♀

113
121
86
84
66
101
118
104
114
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103
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106
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90
121
112
65

5.1
P♂

158
106
200
183
103
147
93
99
90
111

5.2
P ♂

211
111
113
132
93
120
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174
80

5.1
P ♀

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100
118
34
138
92
129
109
106
97
90

5.2
P ♀

144
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128

5.1
F ♂

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5.2
F ♂

74
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108
100
107
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226
224
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220
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5.2
F ♀
85
83
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166

171
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170
173

188

5.11
F ♂

46
43
61
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53
59
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5.11
F ♀
27
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43
40
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5.12
F ♂
173
127
226
141
150
249
178
240
137
200
158
161
178
177
156
178
174
200
140
303
206

5.12
F ♀
235
143
151
143
111

5.12
F ♀
150
116
149
198
156
118
123
140
169
125
125
140
156
141
122
146
174
143
170
120
155

5.21
F ♂
57
54
50
43
54
54
50
57
50
57

5.21
F ♀
38
40
40
42
44
45
42

Gen 3
29
♂
34
44
39
58
50
41
43
41
37
44
38
45
40
40
50
44
32

Gen 3
29°
♀
41
46
36
37
30
31
28
31
36

Gen 4
29°
♂
61
51
46
86
61
43
45

Gen 4
29°
♀♀
37
25
54
27
56
31
47
31
30
51
33
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33
47
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56
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43
47
48
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55
53
37

Gen 5
29
♂
56
95
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57
102
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68
57
103
52
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73
42
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51

Gen 5
29
♂
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69
59
130
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91
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74
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Gen 5
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♀
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Gen 5
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♀
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Exp.6

Males

93
147
125
190
143
140
155
124
121
215
167
126
113
138
92
121
140
177
102
144
87
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107
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197
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189
158
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122
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114
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108
165
136
81
128
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146
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197
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169
113
163
229
120
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140
180
101
142
98
78
97
142
135

Female.

68
99
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108
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104
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111
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141
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120
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88
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111
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81
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Exp.7

Males.

180
99
144
128
164
154
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98
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73
138
106
103
136
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112
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89
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180
153
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182
125
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101
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142
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123
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123
127
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128
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166
104
86
146
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100
110
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128
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123
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130
94
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127
73
122
100
70
86
111
122
138
136
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118
195
92
81
117
86

Females

46
74
72
47
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108
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69
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81
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76
133
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42
74
99
70
66
106
57
55
49

34
54
42
30
50
54
86
54
43
52
60

PARENTS)- 11

1.

135	63
87	40
71	90
110	83
183	64
103	

2.

131	78
98	75
83	69
97	50
95	68
146	59
68	55
94	46
123	
89	

OFFSPRING. 11

1.

69	27
57	27
96	33
59	32
69	30
59	39
41	27
68	23
67	38
63	26
58	20
63	26
68	32
35	31
60	29
	40
	40
	44
	36
	41
	31
	29

OFFSPRING. 11

2.

62	42
65	38
84	51
62	40
70	39
[illegible]	42
57	33
61	53
56	42
62	59
67	48
70	33
61	62
78	38
72	54
64	67
78	34
86	43
70	62
71	56
67	43
46	25
71	36
50	31
79	42
63	30
62	30
70	28
65	33
59	39
63	33
45	37
69	38
65	44
70	33
80	36
63	36
55	28
53	43
59	42
74	54
51	
68	

Parents.
14.1
15.3
17.2

♂	♀
116	74
102	104
140	98
127	44
138	90
101	46
170	64
146	49
113	61
93	85
87	86
82	68
56	50
116	72
166	70
114	107
	89
	44
	78
	79
	63
	68
	108
	62

Parents
14.3
15.5
17.4

♂	♀
90	85
120	91
113	116
114	75
84	81
72	67
109	71
136	78
75	57
91	57
97	69
135	85
131	83
136	66
84	69
	60
	76
	90
	90

Parents
14.5
15.1
17.6

♂	♀
98	45
159	64
152	38
89	77
134	86
161	43
82	84
107	95
108	87
108	90
98	70
109	82
	90
	78
	76
	102
	72
	67

Parents
14.6
15.2
17.1

♂	♀
102	71
94	58
184	90
90	84
112	92
75	53
98	68
145	78
105	67
78	85
81	53
126	102
95	95
111	88
125	80
.	99
	71
	58
	75
	70
	76
	82
	40

Parents
14.2
15.4
17.3

♂	♀
81	78
89	45
60	103
140	85
138	83
133	60
118	74
107	55
122	81
99	53
92	62
107	54
206	58
117	44
	55
	72
	76
	67
	94
	48
	83
	84

Parents
14.4
15.6
17.5

♂	♀
126	70
99	66
82	52
110	56
112	47
93	51
	63
	71
	97
	75
	104
	102
	110
	71
	48
	85
	84

OFFSPRING.

14.1

♂	♀
236	200
366	193
306	288
293	190
251	225
240	238
	273
	223
	172
	147

14.3

♂	♀
300	245
297	262
322	247
384	281
330	240
401	257
345	210
375	223
414	255
403	190
280	240
353	196
382	205
	177
	171
	229
	173
	180

14.6

♂	♀
68	58
65	48
67	39
45	52
74	56
74	60
69	55
57	46
70	41
48	51
75	60
65	57
46	48
80	62
72	49
84	45
72	74
105	65
72	56
51	55
69	54
54	61
63	86
75	56
72	60
73	
64	
65	
80	
130	
83	
95	
77	
54	
97	
96	
131	

14.5

♂	♀
80	56
53	57
83	66
59	55
39	56
66	63
52	67
60	52
64	53
70	58
97	57
84	62
98	56
79	67
161	56
84	60
79	53
56	48
68	50
93	80
76	66
71	

14.2

♂	♀
303	261
325	238
284	243
269	190
306	223
217	208
266	225
238	650*
246	262
	274
	209
	197
	244
	246
	276
	252
	277
	269
	281
	294
	270

14.4

♂	♀
52	51
59	66
65	49
54	43
53	47
52	57
	59
	84
	56
	51

OFFSPRING

15.1

♂	♀
290	180
312	164
324	
292	

15.2

♂	♀
251	170
402	200
254	215
201	196
240	157
260	201
331	233
298	181
233	171
207	188
206	194
286	199
277	130
308	188
282	160
161	198
296	191
	215

15.3

♂	♀
274	180
325	250
248	268
326	[illegible]
	289
	219
	178
	242
	241

15.4

♂	♀
65	36
88	47

15.6

♂	♀
40	66
51	33
50	40
52	36
62	57
73	36
64	45
66	37
64	40
71	53
70	46
57	45
74	46
58	35
88	47
72	40
52	42
47	49
68	40
69	39
74	38
	47
	43
	49
	49
	41

15.5

♂	♀
48	39
53	41
50	55
54	52
74	42
81	32
42	63
49	27
48	41
43	41
47	34
61	51
68	45
43	52
65	39
48	35
98	52
89	39
86	38
	48
	51
	44
	48
	46
	30
	29
	44
	30
	41
	49
	55

OFFSPRING.

17.1

♂	♀
162	137
126	128
108	98
126	172
154	86
118	126
135	80
126	154
106	111
131	125
137	118
121	119
140	116
108	115
135	120
102	94
127	111
157	119
106	109
131	134
157	103
171	110
119	85
113	94
132	118
140	100
99	100
163	97
125	94
112	154
164	130
	93

17.2

♂	♀
167	120
163	121
125	160
198	112
161	137
151	136
	125
	131

17.3

♂	♀
120	93
137	117
96	113
180	80
101	

17.4

♂	♀
83	61
51	46
98	44
36	53
61	79
67	121
111	38
113	86
80	87
105	62
105	34
128	93
87	81
144	62
112	37
117	101
103	46
99	102
147	82
114	61
109	111
123	81
150	79
98	32
121	51
125	68
95	36
99	38
99	54
75	36
101	68
130	100
94	40
117	45
109	81
126	43
132	51
70	93
55	41
113	30
118	90
96	35
97	87
115	52
71	66
	37
	32
	91
	56
	76

17.5

♂	♀
92	48
97	38
48	30
51	43
84	47
43	47
32	36
55	28
59	25
56	35
62	38
62	39
42	29
54	41
55	42
66	42
129	36
59	62
62	47
144	34
33	30
56	34
47	41
71	41
65	34
	33
	38
	38
	55
	31

17.6

♂	♀
62	47
91	46
60	61
69	37
50	51
58	43
58	45
65	48
42	33
58	31
129	46
53	59
70	34
68	50
89	56
73	56
79	38
52	35
51	50
83	38
89	37
90	42
80	42
94	46
62	46
	41
	31
	37
	40

XII.

F Facet No.	A Area	F/A k	F Facet No.	A Area	F/A k
200	268	.747	225	340	.662
288	4 434	.664	261	420	.621
366	635	.577	303	411	.730
306	478	.640	238	343	.695
190	310	.623	243	368	.661
250	409	.623	325	434	.750
303	508	.602	190	290	.655
255	458	.556	223	306	.728
257	405	.652	260	362	.718
223	344	.667	208	351	.593
190	300	.634	262	360	.745
384	520	.739	225	334	.674
330	516	.638	275	410	.670
210	304	.691	216	372	.671
225	363	.620	306	399	.767
238	317	.751	251	371	.676
273	391	.698	280	403	.690
293	408	.694	290	398	.729
62	90	.689	324	432	.750
107	178	.607	401	510	.787
117	226	.517	345	455	.758

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